AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 5, Vol. VIII. New Series.] MARCH 1, 1842. [Whole No. 401. Vol. XIV.

STUART ON RAILROAD PILING.

The communication from Mr. Stuart was received after our article requesting information, in the last number, was in type. It is, however, in precise accordance with the requirements there mentioned, and is therefore peculiarly acceptable. To Mr. S., among other gentlemen favoring us with such communications, we need hardly say that we feel much indebted to them, and that we shall look forward to a continuation of Mr. Stuart's essay.

[For the American Railroad Journal and Mechanic's Magazine.]

ENGINEER'S OFFICE, SUSQUEHANNA DIVISION,
NEW YORK AND ERIE RAILROAD,
ELMIRA, *January* 25, 1842.

GENTLEMEN: In compliance with a request made by you sometime since, desiring further information in regard to the grading by *piling* on the Susquehanna division of the New York and Erie railroad, I herewith send you an *abstract of the weekly reports of the inspectors* having charge of the several steam pile machines which have been in operation during the past summer and fall on this division, by which you will see that the 8 *steam pile drivers* have driven and sawed off, ready for the superstructure, 43.17 *miles of piling for piled road*, in 890 days of 10 hours each; or an average for each machine, of 102 piles per day, *equal to* 16 *rods of grading per day*, or 1.26 *miles per month*. The *largest* number of piles driven by 1 machine in 1 day, *was* 280, *equal to* 34 *rods*; or at the rate of 1 *mile in less than* 8 *days*. The *greatest* number driven in 1 *week*, *was* 1,187, equal to 1 *mile in less than* 11 *days*.

Abstract of weekly reports of inspectors of piled road on the Susquehanna division of the New York and Erie railroad.

No of machine.	No. of days machine at work.	No. of piles driven and sawed off above the surface of the ground.		Total number of piles driven and sawed off.	Largest number of piles driven and sawed off.		Average number of piles driven each day.
		Under 5 feet.	5 feet and over.		In one day.	In one week.	
No. 1	117.7	13,889	151	14,040	230	840	119
" 2	111.7	9,548	1,455	11,003	182	826	98
" 3	129	8,584	1,467	10,051	240	940	78
" 4	98.1	8,150	547	8,697	194	784	89
" 5	116	11,149	1,245	12,394	280	988	107
" 6	128.2	11,688	1,220	12,908	208	1,000	100
" 7	114	13,872	1,627	15,499	269	1,187	135
" 8	76.1	5,200	1,381	6,581	180	642	87
	890.8	82,080	9,093	91,173			

Miles of piling sawed off *less* than five feet above the surface of the ground, - - - - - - 38.865

Miles of piling sawed off *five* feet and over, from the surface of the ground, - - - - - - 4.304

Miles of piling driven and sawed off, (ready to receive the superstructure) in 890 days, averaging for each machine, 102 piles per day, or 1.26 miles per month, - total, 43.169

Miles added, for piling, done by the steam pile drivers, from the 1st to the 22d day of May, (the time that an inspector was appointed specially for each machine,) and you will have the miles of piling done since the 1st of May, - - - - - - - 4.581

Amount, - - - - - - - 47.75

One hundred and eight miles, of this division of the road, *will be founded on piles* of which distance, 74 *miles is now piled, ready for the superstructure.*

The piles used, are mostly of *white oak* timber, from 8 to 30 feet in length, and from 11 to 20 inches in diameter at the butt or top end of the pile. They have been driven through every variety of earth to the depth of from 5 to 25 feet. Every pile is driven

to a firm foundation, and nothing will prevent their reaching the requisite depth, except hard pan or rock. The piles are driven by hammers, weighing 1,000 to 1,400 pounds each; and falling, the last blow, 30 to 35 feet. The fuel required for the machine is principally supplied from the tops of the piles sawed off; and the water used is hauled by horse and cart from the nearest stream or fountain. The machine is propelled by an engine of 10 horse power, and when in full operation, gives 15 to 20 blows by the hammers per minute. Each machine is manned by 9 men, and worked at an expense of $12 per day. The piles are driven 5 feet from centre to centre, longitudinally, and 6 feet transversly.

The expense of butting, sharpening and arranging the piles, ready for the pile machine, averages about $200 per mile. The average cost for working the machine, per mile, $250. *Use* and repair of machine and other incidental expenses, about $250, amounting in all to $700 per mile,—*exclusive* of detention and the expense of taking down and removing the machine from one portion of the road to another. The white oak timber costs, on an average, 3½ cents per lineal foot, or, $1,000 per mile, delivered on the line.

Thus you will perceive, that by the aid of *steam*, we can construct with an ease and rapidity *unprecedented*, a railroad upon a plan *better adapted to our climate*, than any which has heretofore been adopted; and by an improvement, easily made on the machines, used on this work, a much larger amount of piling can be done in the same number of days, than is shown in the foregoing *abstract*; and I do not hesitate to say, that our *steam pile drivers* by a proper application of steam, and with hammers weighing from 1,200 to 1,400 pounds, will drive, on an average, 2 *miles of piling* per month, from the 1st of April to the 1st of November.

I will, in a few weeks, if leisure permits, send you a further statement of our *experience* in the construction of *piled road* on this division, presuming that any information on this *new* and interesting branch of railway construction, will be acceptable to the profession, as well as to your readers generally.

Truly yours,

C. B. Stuart.

Chief Engineer Susquehanna Division,
New York and Erie railroad.

[For the American Railroad Journal and Mechanic's Magazine.]

Gentlemen: Permit me to trouble you with a few more observations in defence of my pamphlet.

It appears to me that you have almost overlooked the subject

which I argued, and confined your remarks to the question raised by yourselves and your correspondent. I did not pretend to discuss the question, whether it be better to adapt the capacity of a railroad and its furniture to the trade existing at the time the work is commenced, or to the *greatest possible* trade which can be antcipated in all future time, or to some reasonable intermediate amount of trade, which the good sense of the company might prompt them to make the basis of their plans. I have treated no such problem, and have written nothing of late on that subject, which is a matter of some importance, certainly, and in many cases will be found deserving of much temperate consideration; but my inquiry was directed to another object.

There are some routes on which railroads are proposed,—extending for instance, from important points on the western waters to commercial cities on the Atlantic,—where a vast trade and travel (say two or three hundred thousand tons, and as many hundred thousand passengers) may "reasonably be anticipated," (such is my language,) and there are many other routes where eight or ten thousand tons and five or six thousand passengers per annum, are more than can ever "reasonably be anticipated." The reasonable anticipations of the one class, are from five to ten, and from ten to fifty times greater than the reasonable anticipations of the other class.

The question is, whether all these roads should be made alike—whether the rails of all should be made of the same strength—the engines of the same weight and power—and the cars of the same size;—whether the same expense should be encountered on all for the purpose of reducing the grades and cheapening the cost of transportation—or whether all these points should be ruled by the character and amount of the trade.

This is the question which I discussed, and I did not even broach the other, which I regard of vastly inferior magnitude, and comparatively of little importance to the community.

I contended with sincerity, and I thought very reasonably—though my view is opposed to the practice which prevails in the country—that a much larger sum might be expended, with good economy, in grading, to reduce the cost of conveyance on one hundred thousand tons, than to obtain an equal reduction on a trade of ten thousand tons. I have thought that as very small engines might carry a very small trade with ease, it would be better to make a permanent, though light and cheap road, to bear the weight of such engines, than to construct a heavy and temporary superstructure, and put on very powerful engines to tear it to pieces.

And I supposed that as eight or ten passengers could be carried very cheaply and comfortably in one or two very light cars, it would be better to employ such cars on small roads, than encounter the expense of the huge boxes usually employed, the weight of which is injurious to the road, and which are rarely if ever half filled. I have deemed it best, to repeat the language of the pamphlet which you condemn, to "make the provision in all cases commensurate with the duties to be performed—the trade and travel to be accommodated."

You do not concur with me in these views, but think with your correspondent, that "the *great* objects and purposes of railways have been misconceived by Mr. Ellet," and that, "the modifying scale required by his plan, though applicable to the steamboat from its transferrable character, is not applicable to the railway, which, as a fixture, looks to the future."

You contend, that to think of adopting my plan, and regulate the power and capacity of a railroad and its machinery merely with a view to the "certain accomplishment of the duty to be performed," to "the economical accommodation of the trade which it is found may reasonably be anticipated," (such is my language,) to make great roads and provide great machinery for a great duty, and light roads and light machinery for a light duty, "would be inconsistent with the onward character of the age," and "return us to an era prior even to the stage coach."

This is the issue. Let public opinion,—or what is much better than *any* opinion,—let a few years' more experience, decide between us.

I am happy to find that there is now but one opinion in respect to the matter of tolls, and that all concur in the propriety of regulating such charges with an eye to the laws which govern trade. This indicates a considerable change within the last few years.

I am much obliged to you for giving place to my views in your useful Journal, and if you can bear with me a little longer, I will endeavor to show you shortly wherein we differ in our estimate of the value of time and velocity.

Respectfully yours.

[For the American Railroad Journal and Mechanics' Magazine.]

REPORT OF THE CANAL COMMISSIONERS OF THE STATE OF NEW YORK.

This report for 1841, furnishes data which may be classified

under the following heads as assisting to give a clearer view of the subject treated of:

Public works and their finances—

	Miles.		
Erie canal,	363		
Champlain canal,	77		
		440 miles productive, cost,	$10,500,000
Oswego "	38		
Chemung "	39		
Crooked lake "	8		
Chenango "	37		
Black river "	38		
Genessee Valley	35		
Cayuga and Seneca	23		
		278 miles unproductive, cost,	7,400,000
Enlargement of the Erie canal, expended up to January 1, 1842, - - - - -			10,800,000
			$28,700,000
Deduct for Erie and Champlain canal, liquidated by tolls, salt and auction duties, *between* 1825 *and* 1840, *or in fifteen years*, - - - - -			10,500,000
Leaving of State debt on 1st January, 1842, about,			$18,200,000

The following sums have been lent by the State to private corporations, and for the due payment of which she is liable:

Delaware and Hudson canal, - -			$800,000
New York and Erie railroad, - -		$3,000,000	
Ithaca and Oswego " - -		315,700	
Canajoharie " - -		200,000	
Tonawanda " - -		100,000	
Auburn and Syracuse " - -		200,000	
Hudson and Berkshire " - -		150,000	
Corning and Blossburg " - -		70,000	
Long Island " - -		100,000	
			4,135,700
			$4,935,700

All these may be considered as ultimately good for both principal and interest.

The State also holds of the surplus revenue from the General Government in *perpetual deposit* the sum of, - - - - - - -	$3,500,000
Contracts have been made for work on the lateral canals and to complete the enlargement of the Erie canal between Albany and Utica, or about half its length, amounting to, - - - - -	$4,600,000
Deduct amount to be supplied from surplus canal revenue in next three years, $500,000 per annum,	1,500,000
Amount required to be raised by loan in the next three years for the above objects, - -	$3,100,000
The estimated cost to complete all the lateral canals and the enlargement of the Erie canal, between Utica and Buffalo, say, - - - - -	$14,200,000

In this statement, New York exhibits the lucky spectacle of having confined her first efforts to the completion of the great MAIN STEM, the invigorating effects of which were allowed to diffuse themselves throughout the State before she ventured to extend the system, when it was still her object to play into the lap of that great artery. The consequence is now seen, in not only the redemption of the entire cost of the main stem in about fifteen years, but the present revenues of her works, besides paying the interest on her present debt of $18,000,000 made up of $11,000,000 expended in the enlargement of the main stem, and of $7,000,000 in the creation of near three hundred miles of laterals, leave a surplus of about $800,000 for other purposes.

But the item of most particular felicitation to the State is, that nearly the whole of the large tonnage passing over the canal, is derived from business created by this very improvement, aided by its laterals and the railways which have been induced along its whole line.

The whole amount of tonnage passing over the main canal is about, - - -		1,450,000
Tonnage passing west from the city of New York to Buffalo for ports beyond it, -	65,000	
Tonnage passing east to Albany from ports beyond Buffalo, - - - -	150,000	
		215,000
Tonnage from business on the line of the canal, tons,		1,235,000

Revenue—

By tolls received,	$2,035,000
" Interest on investments,	141,000
	$2,176,000

Expenditures—

To interest on State debt,	$900,000
" Interest on non-paying railways,	25,000
" Repairs and superintendence of canal,	471,000
" Surplus amount applied to general fund,	200,000
" " " " to other purposes,	580,000
	$2,176,000

Such is this flourishing account which has more than justified the calulations of Messrs. Verplank and Ruggles, of the legislature, in 1838, of an annual increase of $100,000, it having been at an average of $144,000 per annum in the last three years. Thus has this great work completely established its own independence beyond the reach of any rivals, while it must go on annually increasing its resources by the accession of new customers, such as the late connection recently made by it at Albany with the Western railway leading to Boston.

The enlargement is to be regretted as premature; the capacity of the old canal being as yet but little more than about half filled. If it really required relief, the railways on its line ought to have been first tendered whatever there was of surplus; and if the fear of competition from them could ever justify the restrictions on them, still less can it do so now, when the whole cost of the canal has been redeemed from the general funds of the State.

Towards the advancement of railways, the State has done nothing yet on her own account, having contributed her credit only to sundry corporations to the amount of about $4,000,000. Of these, only two have failed to pay their interest, amounting to $24,000, while the deficiency on the lateral canals absorbs about $377,000 from the general revenue. In time, however, these will support themselves besides contributing largely to feed the main canal.

It is now time for the people to understand that the canal or centre tier counties have been even pampered at the public crib, and that those north and south are entitled to their fair share in all future application of the public credit. Their preference is for railways; and if one reason was found to justify in its day the

enterprise of the Erie canal, of which the ample fruits are now before us, there are at least two in favor of that of the Erie railway, founded in ascertained data. The State will scarcely therefore be so direlict of her own true interest as to allow that work to languish, if her further aid be indispensable to insure its completion.

We will suppose these two schemes, which now divide the councils of the State of New York and the opinions of its people, *the enlargement of the Erie canal and the Erie and New York railway*, both partially completed, as submitted to a suitable arbiter, say for instance, Lord Ashburton, whose fiat on questions of this sort would go further with the monied interests of Europe than perhaps that of any other person,—would he not say of the one, that it is premature by at least ten to fifteen years,—of the other, that it offers the most solid security as an investment; and to judge from the experience he had left behind him in the old conntry, as to the vivifying nature of this kind of improvement, its effect on a line of new country like that between the city of New York and Lake Erie, could not be otherwise than marvellous, and that if the question of preference is to be determined only by an *equitable distribution* of State favors, the Erie railway has the best claim. While the profitableness of the investment is UNDOUBTED, why dread going too deeply into it?

[For the American Railroad Journal and Mechanics' Magazine.]

REPORT OF THE CANAL COMMISSIONERS OF PENNSYLVANIA FOR 1841.

According to this report, the public improvements of Pennsylvania now consist of

Finished lines of canal,		656 miles, now cost,	$27,000,000
Unfinished lines—			
North branch division, Lackawanna to Athens,	90		
Erie extension, Greenville to Erie,	60		
Wisconissco canal, Wisconissco to Duncan's island,	12		
	162	" est. "	3,000,000
	818		
Finished lines of railway—			
Columbia,	80		
Portage,	36		
	116	miles, cost,	6,000,000
Amount carried over,	934	" "	$36,000,000

Amount brought over, - - - -	$36,000,000
Add other debts due by the State in turnpikes, banks, etc.,	3,000,000
	$39,000,000

Making a total of $39,000,000 when all her unfinished lines are carried out.

It is utterly impossible to make anything like a satisfactory statement of the working of these improvements,—old debts, repairs and new work are not properly distinguished in the returns,—it is enough to know that with an unconnected *main line* and unfinished and delapidated laterals, the picture thus far is most disheartening.

As the result of these works, the pecuniary requirements of Pennsylvania in 1842, will be about as follows:

To meet interest on her debt, - - -	$1,800,000
" Meet ordinary expenses, etc., - - -	400,000
" Complete unfinished lines of work, say $3,000,000 in all, for this year, say, - - -	1,000,000
	$3,200,000

Borrowing being out of the question, the whole of this must be raised by taxation. It is *more* essential to complete the works than to pay the interest on the finished portions. And if it be a question of necessity for suspending one or the other, let it be the interest, for few will be hardy enough to say that with these works left as they now are, that the debt will ever be worth anything. It is for the holders of her bonds to submit in time to the sacrifice which may be required of them, and come boldly to the rescue of these assets. It is a bankrupt estate with which they have now to deal; and if rightly managed, will yet pay seventy-five per cent. certain, and perhaps a full hundred. It will be seen by the extracts we give below from this report, that a reformation is promised throughout in the general management of these works, upon the salutary effects of which must rest the hope of a gradual and final establishment of the credit of the State now at fifty per cent. below par.

More immediately interested in railways, we have endeavored to understand the working of the Columbia road, and are fully of the opinion that if the State had assumed the entire management of it, and kept it a distinct account, that it would not discredit the fraternity, with all the drawbacks it has had to suffer. An estimate of the expenses on this road for 1842, exclusive of repairs to road itself, is furnished in this report, and to render more distinct the

dead weight and interruption of the inclined plane, we have separated the several items after the following manner :

Motive power—			
Wages to engineers and firemen, equal to 20 locomotives *in constant use*,		$23,000	
Fuel, coal $10,000 and wood $37,500, sawing latter $8,800,		56,300	
Oil,		6,200	
Repairs in workshops, $31,300, and at manufacturers, $8,000,		39,300	
		$124,800	
Deduct for two locomotives between incline plane and Philadelphia, $5,500,	$11,000		
Deduct fuel and oil for stationary engine, etc.,	3,000		
		14,000	
			110,800
Inclined plane—			
Two locomotives between incline plane and Philadelphia, and oil and fuel for stationary engine,		14,000	
Horse power between incline plane and Philadelphia and crossing bridge,		6,500	
Attachers, engineers, firemen and laborers at stationary engine,		6,500	
New rope for plane per annum,		4,000	
Despatchers, etc., on levels,		1,000	
			32,000
General charges—			
Watermen,		6,200	
Water companies,		1,200	
Despatchers, State agents, at Philadelphia, Lancaster and Columbia,		6,300	
State agents to passenger trains,		4,200	
Salaries of superintendent and clerk,		2,500	
Miscellaneous,		1,000	
			21,400
			$164,200

The above is a fair estimate, under the circumstances; and could the inclined plane be abolished, the time gained thereby and the dispensing with the present outlay of $32,000, would make a saving

in the general business of the road of at least $50,000 per annum! And were the forwarding business of freight and passengers done by the Government, the receipts would be increased $50,000. This road and the Camden and Amboy are generally referred to by those who would *wish railways to fail*, and the public seem scarcely yet aware that both, at the present day, are a sort of *satire* on the improvement.

"The Pennsylvania line of improvement is the most central, the most direct, and the shortest route, from the Ohio river to the cities on our Atlantic sea board; and it only remains to make it the *cheapest*, in order to make it the common thoroughfare, and secure the trade of the great region of the Ohio valley."

"To prevent the interruption of the trade of the Ohio river, and the consequent diminution of the business on our canals, a plan has been adopted for a new structure of steamboats to ply on that river, which are adapted to the lowest stage of water, and which, it is believed, will be fully competent to do all the business that will be afforded by the Ohio, during the next and succeeding years. The "Marion" is a specimen of this class; and her success has afforded a test of the experiment which places their utility beyond question or controversy. Several of this kind of boats have been already constructed: they are of a capacity to carry from forty to fifty tons, either in ascending or descending that river. They are built exclusively for *freight*, and with an especial and direct reference to keeping up the trade through the channel of our canal from Pittsburg to Philadelphia. We are happy to be able to state, for the information of your Excellency and the Legislature, that we have the assurance of several of the most enterprising men in the west, that arrangements have been made for such a number of this description of steamboats as will be amply sufficient to do the entire business of the Ohio river during the coming season, and that they will be ready to co-operate with the boats on our canal at an early period."

"The magnitude of the business within the possible influence of the Pennsylvania improvements may, in some measure, be appreciated by contemplating the extent and character of the region of country to which they present, at a slight excess of expense, the most eligible and the safest channel for its immense commerce in merchandize and domestic products. The steamboats now in commission on the western waters number nearly four hundred, about one-fourth of which are owned at, and regularly trade to the Pittsburg district. They are of all classes, adapted to the navigation of all the rivers tributary to the Mississippi; and it is the constant practice of their enterprising owners to send them freighted from

Pittsburg to the remotest accessible ports on the Missouri, Mississippi, Illinois, Arkansas, Wabash, Tennessee, Cumberland, Green, Kentucky, Red and Kenhawa rivers. It is very common, indeed, for boats to go full freighted to Independence, on the Missouri, Galena, on the Mississippi, or Peoria, on the Illinois; and, when the condition of the river is favorable, the freight for the whole distance of eighteen to twenty-five hundred miles rarely exceeds seventy-five cents per hundred pounds, and does not generally average over forty cents to St. Louis."

"The reasonable and equitable rates of transportation, which ought, under some regulation, to prevail on the Pennsylvania improvements, would at once render all these great valleys tributary, and all these steam vessels auxiliary to the complete success of our system of improvements. And thus we should subserve all the purposes of their original construction, enrich the public coffers—establish on a firm basis the commercial and manufacturing prosperity of Philadelphia and Pittsburg, and diffuse benefits and blessings throughout the Commonwealth."

"It seems not only proper, but *necessary*, under these circumstances, that some mutual understanding should take place between the carriers and the State authorities, predicated on a just and equitable revision of the tolls; an abatement of the evils of the present carrying system; and such a reduction of the rates of freight by the several transporters as will render it the *interest* of the business community to adopt the Pennsylvania line, as the *cheapest* as well as the *shortest* and *best route*."

"In order to effect this, the rates of freight must be *fixed* and *permanent*. At least certain *maximum* rates should be at once agreed upon and extensively made public as early as possible; and these rates should be so low as to make the route as cheap at least as any other, for all produce passing eastward, and all merchandize passing westward, *from the commencement to the end of every season*."

"It is confidently believed, and the opinion is corroborated by the most intelligent and experienced traders and merchants, that the result of all this would be, an ample supply of tonnage for the full and constant employment of all the stock now owned on the canals and railways within this Commonwealth."

"As the Pennsylvania canals are opened from four to six weeks earlier than those of New York, we may reasonably suppose that portable boats would be built and used on the Ohio canal. They could be loaded there, make a trip to Philadelphia and *back* again before the New York canals would open. And is it not likely that much of the produce that passes on the Ohio canal to Cleveland, and there awaits the breaking up of the lakes, would be sent to

Philadelphia if boats *could* pass directly from that canal through ours to Philadelphia? And if such diversion of produce could be made, the merchandize for the region whence that produce is sent, would of course, be purchased at Philadelphia, and furnish a return cargo for that description of boats. Every change like this in favor of our route, not only enures to the benefit of the route itself, but incidentally it conduces to the commercial prosperity of all cities and towns *from, through,* and to which such goods and products are passed."

"Another subject requiring the attention of the Legislature, which has heretofore been urged by the canal Commissioners without effect, is the carrying of passengers on our State railroads. One of the principal sources of profit on all railways in this country, and, we may add, in all countries, is the fare accruing from carrying passengers. Indeed, it has been a matter of surprise that the State should so long have neglected to avail herself of advantages to which she is fairly entitled, and which would tend so certainly to enrich her impoverished coffers. The Commonwealth should at once put on her own passenger cars, and transport all passengers on the Columbia and Philadelpha and Portage railroads; which can be done at a very trifling expense—the cost of cars being the principal aditional expenditure required. The State agents who are now employed to count the passengers could, under proper regulations collect the fare, and the number of officers would therefore not be greater than at present; while the receipts on the Columbia railroad would thereby be increased more than $50,000, and on the Portage railroad more than $10,000 per annum. At present, the owners of the several lines of passenger cars, on an expenditure of a few thousand dollars, in all not amounting to more than $30,000 of a permanent investment, realize a clear profit of a much larger sum than is made by the State on an investment of millions. This should be corrected, and the canal Commissioners earnestly call upon the Legislature to take this subject into consideration, and make immediate provisions by law for remedying the evil."

"The distances and maximum gradients of the railroads now rapidly approaching completion, both to the north and to the south of our State, and stretching out their iron arms to draw the wealth of the far west to the cities of Boston, New York and Baltimore, will exhibit, when compared with the routes brought to light by the surveys of the last two seasons, more clearly than anything the Board can state, the advantages which nature has bestowed upon Pennsylvania in making her the channel through which must eventually pass the greatest portion of the vast productions of the west."

"The following table was prepared by the Engineer from data which will be found in his report:

Railroad routes from the seaboard to Lake Erie.	Maximum grade in feet per mile.	Miles to Cleveland.	Miles to Erie.	Miles to Dunkirk.	Miles to Buffalo.
From Boston, via the Massachusetts railroads, and the railroads from Albany to Buffalo - - - -	80	731	611	561	521
From New York, via the Hudson river, and the New York and Erie railroad to Dunkirk	60	640	520	470	510
From New York, via the proposed New York and Albany railroad, and the railroads from Albany to Buffalo -	55	677.71	557.71	507.71	467.71
From New York, via the New Jersey and Philadelphia and Harrisburg railroads, and the proposed railroads from Harrisburg to Pittsburg, (by the middle route,) and from Pittsburg to Cleveland -	45	552	672	722	762
From Baltimore, via Baltimore and Ohio railroad to Pittsburg, and the proposed railroad from Pittsburg to Cleveland - - - -	84	467	587	637	677
From Philadelphia, via Philadelphia and Harrisburg railroad, and the proposed railroads from Harrisburg to Pittsburg, (by the middle route,) and from Pittsburg to Cleveland - - -	45	467	587	637	677
From Philadelphia, via Philadelphia and Harrisburg railroad, middle route to Conemaugh, thence via Freeport and Meadville to Erie -	52.80	585	465	515	555
From Philadelphia, via Reading, Little Schuylkill, Catawissa, and Sunbury and Erie railroads to Erie -	60	555	435	485	525

NOTE.—From each port on Lake Erie where the railroad lines terminate, to the port to which the distance is marked in the table, the distance has been taken by the lake."

[For the American Railroad Journal and Mechanics' Magazine.]

MESSRS. EDITORS: I perceive that Mr. Ellet's recent pamphlet on "The Causes of the Failure of many Railroads" has induced some criticism in your valuable Journal; in these strictures it appears to the writer that Mr. Ellet's views have been essentially misapprehended; for instance, in your February number, you state Mr. Ellet's case thus:

"That the strength of the road, and consequently its cost,—the weight and power of the engines, and the weight and strength of the cars, are to be *in exact proportion to the amount of trade.*"

Now if you had added to this sentence the words, "*which it is found may reasonably be anticipated,*" the case would have been more fairly put, and your criticism would have lost its gist.

To show the importance of the addendum suggested, in order to develope fairly the views of Mr. Ellet, if you will be good enough to turn to page 4 of his pamphlet, you will find the following interrogatory put by him as expressive of his sentiments, viz.:

"What should be the location and character of the road, and the character of its furniture, for the economical accommodation of the trade *which it is found may reasonably be anticipated!*"

You will at once perceive, Messrs. Editors, that this changes materially the face of the question, and renders the most of your strictures entirely inapplicable.

What does Mr. Ellet suggest as a guide for the construction of future works? Nothing more than is required by the time honored aphorism, "*that the means should be proportioned to the end,*" which is aptly illustrated by Mr. Ellet in the statement that, "The power contrived to drive a grist mill, would make but small dividends if applied to turn a churn."

In these ideas there is no novelty,—they are common sense doctrines, which meet an affirmative response in every bosom; and they were, twelve years ago, applied to this very subject, by Mr. Thomas Earle, in a treatise on railroads, published by him in Philadelphia, in 1830; he says on pages 31 and 32, after describing the inconveniences of several modes of forming a general plan to control the location of a railroad:

"Which of these inconveniences is to be preferred, will depend very much on the nature of the country and *the amount of transportation which can safely be expected,* and will therefore be a subject of calculation *in each particular case,* requiring much skill and care in the engineer."

"Where the amount of tonnage will be very great, it may be

true economy to expend a sum in straightening the road and avoiding acclivities, which would be *absolute extravagance* where the transportation will be small in quantity; *for each ton of goods should pay its share of the expenditure, and the shares will be greater or less, according to the number of tons passing.*"

Though Mr. Earle is not an engineer, it would, nevertheless, have proved of vast utility to the community, if the projectors of some of the existing railways, had attended more closely to the judicious admonitions which he spread before them, as long since as 1830, in the paragraphs which we have quoted, and others of the same tenor to be found in his book referred to; and which are now revived in a more imposing form by Mr. Ellet, sustained as he is, *by the experience since that time.*

Touching the question of the best speed for freight trains on railroads, the writer would ask your attention to the experiments of Mr. Edward Woods and others, as a committee of the Institution of Civil Engineers on "railway constants," you will there observe that these gentlemen found that *the minimum resistance of trains on railways* took place when the speed was *six miles per hour*, (the same proposed by Mr. Ellet,) and consequently such a pace would be *the cheapest*, and of course for many kinds of freight *the best* that could be used *for the burden trains.*

Z.

[From the Civil Engineer and Architect's Journal]

REMARKS ON SHIPS OF WOOD AND IRON.

Remarks on the relative advantages of the employment of wood and iron in the construction of ships have appeared at different times, in jounals devoted to inquiries relating to subjects of this nature, but a spirit of partizanship has been commonly displayed by the respective advocates of wood and iron in favour of their own views. In an endeavor to avoid this charge, it will be expedient to advert in the first instance, to the different modes in which wood can be employed in ship building, especially as the advocates of iron are in the habit of referring to the defects of ships built of timber, which are capable of being obviated by a different system of constuction.

The relative merits of wood and iron for this purpose will, I apprehend, come more fairly before the public by an exposition of some of the plans that may be adopted in the construction of ships of wood; and it appears to me that three well marked systems may be distinguished. 1st. The common plan of timbers, whether framed or single, separated by spaces from each other, whose principal connection with each other, arises from an external and internal series of planking. 2d. The plan used in her Majesty's dock

yards, of timbers wedged up solid, and covered by an external planking, (timbers placed close together, I conceive would be found to be a better method.) 3d. A plan of constructing vessels of any size by two or more connected series of planks without timbers; this method has not been extensively used. Clinker built boats belong to this third system, and perhaps also iron vessels, inasmuch as the plates of iron of which they are formed are of far more importance than the iron ribs, which occupy the position of timbers.

The advocates of iron have, I apprehend, by no means exaggerated the defects of ships of the common construction, in which the connection of the timbers with each other is extremely imperfect, even in the best built merchant ships, and the safety of the largest vessels is dependant on the security of the butts of 4-inch plank.

I consider these defects are so fatal that no increase of strength or improvement in workmanship can more than palliate them in a greater or less degree, and I propose to abandon any reference to these vessels, and at once admit their inferiority to vessels constructed of iron, provided the latter are made of sufficient strength.

A large proportion, however, of the present enormous annual loss of merchant ships seems to have been sufficiently traced to defective methods of construction, and to the facility it affords in converting the defects of cheap ships; still the cause that tend to foster the continuance of the present system are subjects foreign to the tenor of these remarks; the fact that the rottenness of the timbers can be concealed from casual inspection, is sufficient for our purposes. It has been urged that unless spaces are provided between the timbers, for the accommodation of water from leaks, that it would rise in the vessel and spoil the cargo. This argument is founded on the assumed necessity of leaks, but it affords proof of their frequent occurrence in vessels of the usual construction.

The rapid destruction of timber by the united operations of wet, heat and filth, and the generation of foul air from these causes will not be denied; and in addition to its weakness the rapid deterioration of the frame of the vessel, from the above causes, seems an equally fatal objection,—though exceptions may occur, owing either to care or accidental conditions.

The second system of ship building with timbers wedged up solid, has been in use for a considerable period for ships of war, and the success that has attended this plan has been amply proved by the accounts of the escape of different vessels, that have since its adoption been driven ashore and got off again, in many instances without injury, and in other cases damaged to such an extent as would have insured the total loss of vessels of the common construction; for instance, the *Pique* lost a large portion of her keel, and in some places the whole of the starboard streak, and a part of the floor timbers were ground away by the rocks of Newfoundland, and yet this frigate crossed the Atlantic without a rudder, under circumstances, it must be admitted, of some anxiety to the officers and crew.

For merchant ships I should propose to use the same weight of materials as are now employed, the outside planking would remain

without alteration, but the quantity of wood in the ceiling would be added to the width of the timbers, and in case it was insufficient to fill up the spaces between the timbers, the depth of the latter must be lessened to make up the deficiency.

Under these circumstances the timbers would be about double the thickness of the outside planks, and being placed close together, a good means of connection might be obtained by large dowell or coaks, so as to produce a mutual dependence on each other, and so that any pressure on the outside would exert a more regular strain on every part. A vessel constructed on this principle would be an irregular cask, and when caulked inside and outside would float without planking; and by the addition of the latter, a frame of great stiffness, and equal strength and thickness in every part would be obtained, on which one side of every piece of wood used in its construction would be visible, and would allow an examination to be made of its state with great facility. The other sides of the wood would be preserved from wet as long as the fabric of the vessel remained sound, and the caulking was attended to. It is obvious that a greater inside width of 7 or 8 inches would be gained in these vessels, and no loss of space would accrue if it was occupied by battens to admit of water accommodation for the leakage, and the prevention of injury to the cargo from the escape, until at least the present advocates of the assumed necessity of leaks in ships, became convinced of the small prospect of their occurrence under common circumstances in vessels so constructed.

It is true no provision will afford security to vessels on rocks among breakers, but such situations afford the best test of the merits of different systems of ship building, by the time each vessel is found capable of resisting these effects.

Numerous cases will occur where life is dependent on the time the vessel holds together, but the partial saving of the cargo may be considered objectionable by ship owners, among whom the advantages of a total loss are well understood. Opinions on these points are of little value, we must wait for evidence from wrecks under different conditions.

The scantling proposed for merchant ships would, I apprehend, be not quite so heavy as that in use for ships of war of equal size; at the same time, it is probable that the strength of timbers placed close together, except that of the dockyard plan of timbers wedged up, to such an extent that a greater strength may be perhaps obtained at a smaller cost. Plans of this nature are obviously only suited for good workmanship and good materials; but it ought to suit, for less insurance premiums, whenever an inquiry on this subject is properly conducted, and explanations are afforded to insurers of such a nature, as shall be fully understood.

The third plan referred to, requires similar conditions of timber and workmanship, but it has not been extensively adopted. Ten or twelve series of inch planks were employed many years ago, in a 500 ton vessel built at Rochester, but I conceive three or four series of 2½ to four inch plank, according to the size of the vessel, would be found a more convenient method of construction.

Several of the Gravesend steamers of 150 feet in length have been built of three series of 1½ inch planks, and they have run for 4 or 5 years, and are now said to be as sound as when first constructed, such at least was the case with the Ruby, when opened for the purpose of lengthening the bow to increase her speed.

This method however requires farther trial, especially at sea, before any decisive opinion can be given on its comparative merit; it is favorable to soundness, as the necessity of sawing the wood into planks admits of the certain selection of good materials, and would afford great facility in seasoning timber properly. While the expense of selection would in some degree be lessened by the conversion of the rejected planks to inferior purposes, or by working it up in inferior or cheap craft, perhaps for river use. The increase of cost would not answer unless it was accompanied by a proportional increase of durability, and perhaps the general opinion would be in favor of the latter result, as a necessary consequence of the selection of good timber.

The launches used in the navy have for several years been made on Johns' plan, of two series of planks crossed diagonally, their weight is about ⅔ of the boats of the old construction, and their durability has been much increased. The Gravesend steamers are built with two similar series of crossed planks in lieu of timbers, covered with an outside planking in the common mode, the whole well fastened with copper,—in large vessels perhaps a ceiling connected in the same manner might be deemed advisable: at the same time it seems probable that a greater strength would be obtained by a less quantity of timber in the third than in the second method of construction proposed. Clinker built which belong to this class, in which the principal strength depends on the planking instead of the timbers, seldom exceed 100 tons in size, and are usually of a slight scantling; their great durability is well ascertained, provided they are kept from the ground, in which case from the thinness of the single part of the planking, holes are easily knocked in their bottoms.

The introduction of these methods of constructing timber ships is not likely to be effected, except by the nearly total destruction of the present trade in ship building, by the more general adoption of iron vessels, and the interest of humanity will cause the earliest occurrence of this result not to be regretted. Nothing perhaps but the severe pressure of iron competition will induce the present race of ship builders to turn their attention to the means whereby greater strength, security and durability may be given to wooden ships; eventually perhaps its greater strength for a given weight, and its greater elasticity may obtain a preference.

Prime cost undoubtedly will form a principal element in the approaching competition; at present iron vessels are often built too cheap, or in other words too slight; the error may be, and I believe has been remedied. Innumerable questions will arise relating to the elasticity, strength and durability of wood, as well as its quality; and also in reference to the destructive action of salt water on iron, the strain on the rivets, etc. etc., which can only be answered by experience.

To a spirited competition between wood and iron, I look for the improvement of vessels of both materials. Recently I have met with parties who being engaged simply as owners on the proposed construction of a steamboat, in consequence of the difficulty in the choice of wood or iron, have found it necessary to institute an inquiry respecting their relative merits in ship building; these parties, but for the difficulty of selection, would have gone on in the good old jog-trot way of supposing that British ships of the old construction were perfect specimens of the art, and would have patiently submitted to the present rates of insurance, as founded on the average loss, deduced from defective ships. The spirit of inquiry once aroused among owners of shipping, will I trust lead to results as yet scarcely anticipated.

It matters little to the country whether wood or iron eventually obtains the preference; if British iron, and the inhabitants of our land ought to be satisfied if the latter will uphold the character of the navy as well as the former has done.

At present I consider the question of relative superiority as undecided, and though disposed to admit the inferiority of timber vessels of the common construction, yet the advantages of iron may not exceed that due either to the methods of construction adopted in the navy, or in the Gravesend steamboats. The latter method is perhaps best adapted for small, and the former for large vessels. Moreover, we want the evidence likely to be afforded by the wreck of the largest iron steamers, for the formation of an opinion respecting their powers of endurance under the breakers of a rocky shore or a sand bank.

In regard to the relative advantages of the two plans of ship building proposed for the merchant service, the method adopted in the navy has received the stamp of experience, and the evidence is conclusive in its favor. The 500 ton vessel built of planks before alluded to, was driven on shore in a heavy gale under Mount Batten, in Plymouth sound, when loaded with ordnance stores, in company with 10 or 11 other vessels, all of which became total wrecks; she afforded an almost solitary instance of a vessel saved, when ashore on that point, and she is reported to have rebounded from the rocks for a short time like a cask, until a hole was knocked in her bottom; after the gale she was got off, and was repaired at a moderate expense, and proceeded on her voyage to the East Indies.

I should also be inclined to the opinion that a greater strength will be obtained with a less quantity of materials, by means of several series of planks than by close timbers and outside planking, but the latter plan seems to afford greater facility for repairs. In conclusion, I would remark that it is my object to assert the possibility of the introduction of great improvements in the construction of vessels of wood, without an increase, and perhaps at some reduction of cost, and I wish to induce parties engaged in ship building to advert to the fact, that the best portion of their business, the construction of steamers, is rapidly passing out of their hands, and that unless sailing vessels are rendered stronger, safer and perhaps lighter, this portion of their trade may follow, as the establish-

ments for building iron vessels are increased, or at least such a depreciation of prices may occur as will be equally ruinous to them.

At the same time I must acknowledge that great improvements in regard to strength have been necessary, and have been adopted in many of the larger steamers, in some instances perhaps to the full extent here advocated, at least in the engine room; similar principles might be adopted in the fore and after bodies with lighter timbers, and hence a less strain would be thrown on the midship body in passing over heavy seas. It is their general adoption that I would urge, and I cannot but express my conviction that steamships of the largest class yet made, may be constructed to bear the winter seas of the Atlantic, by a better disposition of the timber employed in their construction.

HARRISBURG AND PITTSBURG RAILROAD.

The contemplated Harrisburg and Pittsburg railroad has for its immediate object the connection of these two points, but it should also be considered as the main link of a contemplated railway communication between Philadelphia and St. Louis, with branches to Cleveland, Cincinnati, and other central points. Viewing it in this light, we are astonished at the great indifference evinced by the citizens of Philadelphia, to a plan which should be entitled to their highest consideration, as involving to a great extent the question of their future commercial prosperity.

A perusal of the last report on the New York and Erie railroad, has convinced us that the merchants and capitalists of New York have become awake to the great importance of an uninterrupted communication with the lakes. It appears they have been aroused by the vigorous efforts of the Bostonians, who have already accomplished a continuous line of railroad from their city to the lakes, which with the aid of Cunard's steamers forms a direct communication between the valley of the Mississippi and Europe.

While we were involving ourselves in bankruptcy by insane bank operations our wise neighbors in the east were looking ahead, and discovered that the investment of eleven millions of capital, in the construction of a road to Albany, would be the best "regulator" of their future commercial transactions, and doubtless it will prove a mighty "balance wheel" always working in their favor. Baltimore as well as New York is emulating the example of Boston, and their citizens are exerting all their energies to finish the Baltimore and Ohio railroad to Pittsburg.

The question naturally arises, what will become of the commerce and travel of Pennsylvania, and especially in what condition will Philadelphia find itself on the completion of the Boston and Albany line, the New York and Erie, and the Baltimore and Ohio line? We answer, it will operate so powerfully upon the interests of Philadelphia, that its property will at once depreciate and its population decline. Our friends in the city may rejoice that their future prosperity depends upon the developement of the mineral resources of

the State, and that they must devote their energies to manufacturing. Very true, to a certain extent, and we wish you success with all our heart. But let us remember that the Pennsylvania canal has been mainly conducive to the present greatness of Philadelphia and Pittsburg, by facilitating the transportation of goods and passengers. It is no exageration that our canals have raised the value of the two cities at least $60,000,000. But as they are locked up in winter and do not answer the purpose of travelling, you want in addition a continuous railroad which with your other resources will place your future business above competition.

We have always been a steady advocate of a judicious improvement system, and are not willing to abandon it now, when it is forsaken by many of its former friends. Undoubtedly the system was commenced on a scale too extensive for the immediate wants of the country, and we have to bear the consequences of this error and be on our guard for the future. But yet Pennsylvania is much better off with her present debt and improvements than without them. The apparent failure of these improvements has turned the tide of public opinion against the whole system, the innocent suffer with the guilty, and railroads along with the rest have sunk in public estimation.

In our opinion, there is no State in the Union in which railroads should be more advocated than in Pennsylvania. The vast sums transmitted to England for railroad iron, have gorged the coffers of the nabobs of Wales, leaving us in debt to a vast amount. How much better would be our condition if this railroad iron had been procured from our own mines and rolling mills. And we are yet in hopes that common sense enough will be found in the country, to arrest the sending of our specie to Europe, to procure a material which abounds in our own soil in the gratest profusion. Suppose a protective tariff should prohibit a further importation of railroad iron, what a source of revenue would arise to Pennsylvania from the construction of railroads in other States? In a few years railway stocks will rank highest in the stock market, and why should not judiciously constructed railroads, which accomodate a large and regular business and yield dividends of from ten to twenty per cent., be more than equivalent in value to real estate? And among all routes the Philadelphia and Pittsburg line must from the nature of things, become one of the most productive roads in the Union.

After the three great railway lines, now being constructed between the borders of the Atlantic and the valley of the Mississippi, have been completed and in operation for some years, the greater part of the travel and business of Philadelphia will be diverted, and that city will find herself placed in a dilemma from which she can only extricate herself by the speedy construction of a railway of her own. The question then arrises, how is such a desirable object to be effected; is there a practical route through Pennsylvania, able to compete with the other rival lines, and is there a reasonable prospect that the capital expended on such a work would prove a good investment? To these inquiries we can return the most satisfactory answers. But let us first dwell upon the comparative merits of the

Pennsylvania route. It will be reserved for a future article to show beyond a doubt that investments in this road would in less than ten years prove the best railroad stock in the country.

Many of our citizens are not aware of the fact now established by the Harrisburg and Pittsburg railroad survey, that our own State possesses the best and shortest route for a railway between tide and the Ohio river and the lakes, and that this route is so much superior to all the other routes, that it will, if constructed in season and ably managed, become the great thoroughfare between the east and west.

The survey for a continuous railroad from Harrisburg to Pittsburg, authorized by the legislature three years since, is now completed. Very fortunately this important task was entrusted to Charles L. Schlatter, Esq., as principal engineer, to whose talent, sound judgment, and unwearied industry, we are indebted for the happy result. We refer to the second report of this gentleman, where the distance by the so called middle route from Philadelphia to Pittsburg is stated at 348 miles. We have been informed that he has since succeeded in effecting a reduction of distance of 11 miles between Jack's narrows at the forks of the Kishacoquillas creek and Dorsey's forge at the gap of the litle Juniata through Tussey's mountain, by resorting to a tunnel through Stone mountain. Being well acquainted with that region, we consider it a just tribute due to the engineer, to state that he has, in our opinion, by the location of the line, evinced a high degree of professional skill. When this road is constructed, the Stone mountain line will be looked on as a proof, how difficult formations of the ground, and obstacles apparently insurmountable, can be overcome if throughly examined by a competent engineer.

The total distance from Philadelphia to Pittsburg is therefore now reduced to 337 miles, and with no gradients exceeding 45 feet per mile. The distance from Baltimore to Pittsburg, by the Baltimore and Ohio railroad, is about the same, but we believe there are grades on that route of 66 feet per mile, and even one of 84 feet per mile. This rival line appears therefore much inferior to the Pennsylvania route, and will not draw any business from Philadelphia by superior facilities of transportation. In his comparrison between the Pennsylvania and New York routes, Mr. Schlatter has assumed Cleveland as the most suitable point of termination in the west.

The distance from Philadelphia to Cleveland, via New York and Erie railroad, and lake, is	640 miles
The distance from Philadelphia to Cleveland, via Pittsburg, - - - - - -	467 "
Difference of distance in favor of Philadelphia,	173 "

Besides this great difference of distance, we must observe, that the maximum gradients upon the New York and Erie railroad rise as high as 60 feet per mile. As the distance from New York to Cleveland, via Philadelphia and Pittsburg, is 88 miles shorter than by the New York route, and as the grades on the former are more

favorable and no danger from the lake navigation, the merchants of New York will prefer sending their goods by the Pennsylvania route.

The distance from Boston to Cleveland, via the Western railroad, is 728 miles, therefore 261 miles further than from Philadelphia to Cleveland. The gradients on that road are also less favorable than on the Pennsylvania route.

Owing to the mixed nature of our present line of improvements, we shall never be able to compete with New York in the transportation of heavy freight while the Erie canal is open. The low stage of the Ohio river during a part of the summer season, also diverts much of the western trade from the Pennsylvania channel, and sends it through Ohio and New York. But by constructing the Harrisburg and Pittsburg railroad, and extending it to Cleveland, Philadelphia will at once monopolize the winter and spring business, and nearly the whole of the travel beyond competition.

There is certainly cause of congratulating the city of Philadelphia on such fair prospects, and well does she need it in her present gloomy situation. We may be told by some that it is quite out of time to talk of new improvements, but we do not coincide with such opinions. This is the very moment to offer some consoling reflection, some bright prospect for the future, no matter how distant. We do not promise the immediate formation of a company for commencing the line in question, but we most earnestly advise all those who have the future prosperity of Pennsylvania and especially of the city of Philadelphia at heart, never to lose sight of the fact that Pennsylvania has the best railway route between the Atlantic and the valley of the Mississippi, and that such a work should be commenced as soon as our means and credit are sufficiently restored. We should not allow our neighbors of the east and south to indulge in the prospect gradually absorbing our interests; we should understand our own position, define it clearly before the public, and determine to avail ourselves of it at as early a period as possible. We are conscious we are advocating a measure which richly deserves it, and which promises a fair result, if attended to in season.

The rapid strides of improvements in steam navigation on the ocean, clearly show that our shipping is undergoing a radical change. There is no doubt the consumption of fuel in steam navigation will shortly be reduced to the minimum the nature of steam will admit, which has long been attained in the Cornish engines. No good reason can be assigned, why the difficulties attending upon the expansive use of high steam in navigation, should not be removed in a very few years. This once accomplished, steam ships will multiply, and Philadelphia no doubt will soon own a large interest in this species of navigation, and her ships will be moving in all directions, propelled by our anthracite coal. With the aid of her steamers and the most direct railway communication with the west, Philadelphia may again resume her former proud position among her sister cities.

But let us not forget the ways and means by which such desirable

objects are to be accomplished. The Harrisburg and Pittsburg railroad, which has given origin to the above remarks, is to be considered as the first step towards re-establishing her former supremacy.

Let us look upon the money appropriated by the State for the Harrisburg and Pittsburg railroad survey as well expended. The knowledge of the fact that Pennsylvania possesses such a favorable route, enhances the value of the whole State.

We conclude this article by congratulating the public upon the happy result of these surveys, and as we feel more than a common interest in this matter, we cannot take leave of it, without paying a well deserved compliment to the talented engineer, Mr. Schlatter, for his successful labors, and we heartly wish that those who control our public improvements may be farther disposed to avail themselves of his valuable services.—*Pennsylvania Reporter.*

[From the Civil Engineer and Architect's Journal.]

ENGINEERING WORKS OF THE ANCIENTS.

The Greeks.—The silver mines of Attica (book 9, chapter 1,) were formerly very productive, they are now exhausted. When they still produced a slight return for the labor of the miners, they melted up the old rubbish and scoriæ, and a considerable quantity of very pure silver was obtained from them, seeing that the ancients were not very skillful in the art of extracting metal. A commentator remarks on this passage that it is a proof of the progress of mining in this age, but that even then the Romans had by no means gone to the extent of modern art, as sufficient is still sometimes found in Romish scoriæ to pay for the expense of extraction. He farther observes that the mines of Laurium showed signs of exhaustion in the time of Socrates (Xenophon Memorabilia, book 3, chapter 6, § 12.)

In the next page Strabo notices a bridge over the Cephissus.

In book 9, chapter 2, our author gives a description of the works on the Euripus, but one which is very inaccurate.

Speaking of the plains of Beotia opposite to Eubea (book 9, chapter 2,) an account is given of the works undertaken to drain them, by a contractor for works, of the name of Crates of Chalcis. He was obstructed by the factions among the Beotians, but in a report, addressed by him to Alexander, he relates that he had already drained several large tracts. This contractor is also mentioned by Diogenes Laertius, book 4, § 23, as being employed by Alexander.

In book 10, chapter 1, is an obscure passage relative to the mines of Chalcis.

In the same, chapter 3, Strabo refers to the labors of Hercules on the Achelous.

The Rhodians as well as the Cyzicans and Marseillese were famous as military engineers, (book 14, chapter 2.)

Cilicia.—Book 12, chapter 1, contains an account of the mode in which King Ariarathes the 10th stopped up the Malas, a feeder of the Euphrates, and how the dike having burst and caused injury to the neighboring lands, the king was fined 300 talents by the Romans.

Pontus.—Chapter 2d of the same book describes the mode of working the mines of Sandaracurgium.

Ephesus.—The entrance of the port of Ephesus is too narrow, the fault of the architects and engineers, who were led into error by the king, who employed them on this work. This prince, who was Attalus 2d, Philadelphus, king of Pergamus, seeing that the port was being silted up with banks from the deposits of the Cayster, and thinking that it could be made deep enough to receive large vessels, if a mole were thrown before the entrance which was too broad, ordered the construction of the mole. The contrary however happened, for the mud filled the port with shoals as far as the entrance, whereas before, the deposit was sufficiently carried out by inundations, and by the reciprocal movement of the waters of the outer sea. Such are the defects of the port of Ephesus (book 14, chapter 1.)

Persia etc.—Alexander in his expedition to Gedrosia was preceded by miners to search for water, (book 15, chapter 1.)

In book 15, chapter 3, a bridge is mentioned as being thrown over the Choaspes at Susa.

In the next page sluices are mentioned on the Tigris.

In book 16, chapter 1, an enumeration is made of the works of Semiramis.

Alexander destroyed a number of sluices on the river Tigris. He also occupied himself with the canals, which are of the greatest importance to the agriculture of that country (B. 16, chapter 1,) a theme upon which our author dwells at some length. He relates, on the authority of Aristobulus (see also Arrian, B. 7, § 22,) that Alexander seated in a boat steered by himself, attentively surveyed the canals, and caused them to be cleaned by employing a great multitude of men, whom he took with him. He also had certain outlets closed and new ones opened. He remarked a canal, principally leading to the lakes and marshes on the Arabian side, and the outlet of which, on account of the softness of the ground, could not easily be closed; he therefore opened a new canal or mouth about 30 stades off, in a rocky ground, through which he turned the waters.

Egypt.—In his 17th book, Strabo describes Egypt. He mentions the skill the Egyptians showed in hydraulic works, but the fact upon which he dwells is partly perhaps attributable to Roman science. He says that before the time of C. Petronius (chapter 1) Governor, A. D. 20, that the greatest inundation and most abundant harvest took place when the Nile reached fourteen cubits, but that under the administration of that governor an inundation of twelve cubits produced abundance.

In that book and chapter there is frequent mention of canals and there is a description of the canal of the Red sea. (See also Diodorus Siculus, B. 1, § 19 and 33.)

Here also Strabo describes the Egyptian mortar as being made of pounded basalt, brought from the mountains of Ethiopia.

Pausanias—Ælian and Appian.—In Pausanias the only notices

in any way relating to our subject are an allusion to the silver mines of Laurium in the commencement of the Attics, and in the Laconics a statement that Eurotas diverted the river. Ælian and Appian there is nothing except perhaps that the latter, in the account of the siege of Carthage, mentions a cut made through the harbor by the Carthaginians.

Arrian.—Arrian in his life of Alexander, 7th book, chapter 21st, gives a better account than Strabo of Alexander's repair of the canal called Pallacopas, although this latter account differs, we shall content ourselves with a reference to it. We may observe that Gronovius has annexed to his edition of Arrian a small treatise on this canal, which embodies all the account and modern information respecting it.

In his second book Arrian devotes much space to the siege of Tyre, from which we shall extract some of his remarks on the mole. He says that the sea there, has a clay bottom, and shallow towards the shore; but when you draw near the city, it is almost three fathoms deep. As there was abundance of stone not far off, and a sufficient quantity of timber and rubbish to fill up the vacant spaces, they found no great diffculty in laying the foundations of their own rampart; the stiff clay at the bottom, by its own nature, serving instead of mortar, to bind the stones together. The Macedonians showed a wonderful forwardness and alacrity to the work, and Alexander's presence contributed not a little thereto; for he designed every thing himself, and saw every thing done. In describing the subsequent operations Arrian says that many engineers, meaning military engineers, were brought from Cyprus and Phenicia.

In the fifth book a long account is given of the mode adopted by the Romans, and particularly by the old Romans, in forming temporary bridges for crossing large rivers.

CAPACITY OF THE CHESAPEAKE AND OHIO CANAL.

Some persons, says the Baltimore Patriot, have doubted whether this canal will have capacity to pass the freight adequate to pay an interest on the outlay for the work. To such, it is well, at this time, to give reference to a part of the report of the company, made to the stockholders in August, 1839. The passage is as follows, and it certainly shows, on the most authentic data, the abundant ability of the canal, when finished, to accommodate freight far beyond the amount of interest on the cost of the work. (The quotation is from page 27 of the report.)

1. *As to the capacity of the canal.*—On canals of four feet depth, with locks of fifteen feet wide and ninety feet long, it seems to be ascertained that the most economical medium of navigation is a boat carrying fifty tons. The depth of the Chesapeake and Ohio canal being six feet, the dimensions of its locks being 15 feet in width by 100 in length, it is supposed that boats of 80 tons will be best adapted to its use. Much larger loads may be readily trans-

ported; but we have assumed that of 80 tons as, in general, the most convenient and economical. The navigation on this canal, judging from actual experience and observation, will exceed rather than fall short of 300 days in the year. The longest season of navigation on the Erie canal, for the fourteen years preceding 1837 inclusive, was 269 days; the shortest, during the same period, was 216 days. In the year 1835, of 230 days' navigation, 25,798 boats and rafts passed through one of its locks in the two directions. In 1836, of 216 days' navigation, 25,516 boats, etc. passed. The average of these two years would be equivalent to 34,516 boats, etc. for a year of navigation of 300 days.

The largest number of boats, etc., which have passed on the Erie canal, during the same period of 14 years, in any one month, was, in October, 1835, viz 4,215; that is, 136 per day; which is equivalent to 40,800 for a year of 300 days.

The greatest number of boats which have passed in one day through a lock on the Erie canal, so far as we have any official statement on the subject, is 302. At this rate, the year of navigation of 300 days would be 90,600.

The locks upon the Erie canal are single, as are at present those on the Chesapeake and Ohio canal. The latter, however, have all been constructed with a view to double lockage, when the exigencies of the company require it. The intelligent officers of the Erie canal, who have furnished the foregoing statements, concur in the opinion that the double locks would increase the facilities to the extent of two-thirds. The opinion is also distinctly expressed, that, although under very favorable circumstances 302 boats have passed in a single day, 250 may be taken as the number which may conveniently be passed.

From these data, derived from a long experience, we are led to these results:

	Single locks.	Double locks. (Two-thirds increase.)
1. Boats etc. which have actually passed, in 1835, in 230 days, as above - -	25,798	42,996
2. Do. do. in 1836, in 216 days - -	25,516	42,526
3. Assuming 300 days of navigation for the year, and the average of the two years above would be - - -	34,516	57,526
4. Assuming the same year of 300 days, and the rate of the greatest month's work would be - - - -	40,800	68,000
5. Do. do., assuming the rate of the greatest day's work as above, 302 -	90,600	151,000
6. Do. do. do., assuming the rate, which it is represented, as above, may be safely estimated for a day's work, 250 -	75,000	125,000

Estimating the boat load at 80 tons, the amount transportable,

according to the foregoing table, number 4, would be, with single locks, 3,264,800 tons; and with double locks 5,440,532 tons. In like manner, estimating the load at 80 tons, and applying it to the sixth item in the foregoing table, the result would be with single locks 600,000, and with double locks 1,000,000 tons per annum.

According to the present tariff, the toll upon coal, which is the lowest article, amounts to one dollar per ton from Cumberland to Gorgetown; and supposing one-half of the tonage in the last preceding statement to be descending coal, that there should be no ascending trade, and the boats always return empty, the amount of tolls, upon the first of the above statements, would amount to $1,634,400 per annum with single locks and $2,720,266 with double locks.

Apply the same ratio of calculation to the second estimate, and the result would be $3,000,000 with single, and $5,000,000 with double lockage. Each individual may judge for himself of the probability of the data upon which the foregoing estimates have been formed, and vary the results accordingly.

A. B.

NOTE.—The present winter, (1841-'42,) the navigation of the Chesapeake and Ohio canal might have continued to the present time, (January 17th.) The navigation of the Erie canal was long since closed.

C. B. F.

National Intelligencer.

LOCOMOTIVE PERFORMANCE.

MR. EDITOR: By the following statement of the power of locomotives, it would seem that the system of transporting freight by railroad has been brought to such perfection, that they may be fairly put on a par, as to econemy, with either canal or river transportation.

PHILADELPHIA, *February* 12, 1842.

Messrs. BALDWIN AND VAIL; Gentlemen,—I send you enclosed, a statement of the performance of your new six wheeled, geared engine, which you will perceive is in every way satisfactory. The train weighed 108½ tons, of 2,240 lbs., more than that hauled by your "Hichens and Harrison" engine in February last, on our road.

Statement of the performance of a six wheeled engine, built by Messrs. Baldwin and Vail, on the Philadelphia, Reading and Pottsville railroad, February 12, 1842.

This engine has six wheels and outside connections. The large drivers (44 inches in diameter,) are behind the fire box, and connected with the 4 truck wheels, (33 inches in diameter,) by cog gearing, in such a way as to obtain the adhesion of the whole weight of the engine, with little additional friction, and at the same time allow the requisite play in curves.

Her weight, in running order, is 30,000 lbs.; on her large drivers, 11,775 lbs.; or 5,887 lbs, on each; On the truck wheel 18,225 lbs. or 4,565 lbs. on each, and her cylinders are 13 inches diameter and 16 inches stroke.

This engine hauled, on the above date, a train of 117 loaded cars, weighing in all 590 tons, from Reading to the inclined plane, on the Columbia railroad, 54 miles, in 5 hours and 22 minutes, being at the rate of over 10 miles per hour the whole way.

She consumed $2\frac{4}{10}$ cords of wood, and evaporated 3,110 gallons of water, with the above train. Weight of freight, 375 tons, of 2,240 lbs.; consisting of 259 tons of coal, 22 tons of iron and nails, and 94 tons of sundry other merchandize, including 53 live hogs, 10 hhds. of whiskey, 188 bbls. flour, ship stuff, butter etc. Weight of cars, 215 tons, making a total weight, not including engine and tender, of 590 tons of 2,240 lbs.

Whole length of train, 1,402 feet, or 82 feet over a quarter of a mile. The above train was transported in the ordinary freight business of the road, and was run without any previous preparation of engines, cars or fuel for the performance. The engine was closely watched at all the starts of the train, and not the lest slipping of any of her wheels could be perceived. She worked remarkably well throughout the trip, turning curves of 819 feet radius, with ease to her machinery, and no perceptible increase of friction in her gearing. Her speed with the train on a level, was found to be 9 miles per hour.

Whole length of level, over which the above train was hauled, 28 miles; longest continuous level, $8\frac{1}{10}$ miles; total fall, from the point where the train was started to where it stopped, 210 feet.

The above train is unprecedented in length and weight, in Europe or America.

G. A. Nicholls,
Superintendent of transportation on the Philadelphia, Reading, and Pottsville railroad.
U. S. Gazette.

BITUMEN.

A new application of this material which promises to be of very great service in engineering works, has lately been successfully practised by the Parisian Bitumen company. The new application consists in cementing large masses of rubble stone with the bitumen in a liquid state, and this has been successfully practised on a very extensive scale on the works of the Upper Medway Navigation company in the following manner.

The river is divided into levels by weirs and locks in the usual manner. Some of those wiers are constructed at great expense of squared masonry; others are less expensively constructed, by throwing in the rubble stone of the country to the desired shape and height of the weir; it may be remarked that no care is taken in bedding the stones, or in laying them, which is performed by the ordinary laborers of the country. The bitumen is then melted and run in between the stones, and the whole forms a mass of such solidity as to resist the heaviest floods, and is perfectly impervious to water in every part, and it is supposed that it will not require one-tenth of the repairs usually bestowed on weirs of the ordinary construction.

It may be noticed that previous to this material being used, the repairs after the winter floods, which are very heavy, were very great, and caused considerable interruption to the traffic.

The great advantages arising from using the bitumen in the manner described are cheapness and facility of construction—a very considerable reduction in the expense of repairs. It is evident that this may be used to very great advantage in foundations of bridges or large buildings, as forming a compact body capable of resisting any pressure, bearing any weight that may be imposed on it, and becoming perfectly solid in five minutes after being laid; it will effectually prevent vermin from getting into houses or burrowing near the foundations.

The manufacture of bitumen is now brought to great perfection by the same company. Some beautiful specimens of tesselated pavement are being laid of different colored bitumen, and floors of stations, churches, halls, etc., may be made very ornamental, and equally durable with Yorkshire stone, while it is much warmer to the feet and not more than half the price.—*Civil Engineer and Architects Journal.*

Increase of Revenue on Railroads.—The nett revenue of railroads has generally exceeded the prediction of their friends. Take for instance, the Lowell railroad. Its friends issued a pamphlet, before it was subscribed for, and predicted in this pamphlet, that its nett annual revenue would be $36,000. This nett revenue has been, in

1836	$89,798
1837	102,261
1838	116,180
1839	149,068
1840	140,175

Twenty-five miles (the length of the Lowell railroad) give $140,175 nett revenue per annum. If, then, the Western railroad gives in proportion to its length, (155 miles) its nett annual revenue will be $869,000.

Is the Lowell railroad (of which, before it was built, the nett was estimated at $36,000 a year) a greater channel of communication, naturally than the Western railroad, built in continuation of the Erie canal? of that Erie canal on which the freight, paid this year, will exceed $4,000,000?

Again—the tributary sources of a railroad increase in a ratio much greater than in proportion to its length—because the longer the road is, the wider the strip of the country whence it draws its tributary sources of revenue. A man will travel 30 miles on the common road, out of his way, for the sake of going 100 miles on the railroad—while he would only go 10 miles out of his way on a common road, for the sake of using 33 miles of railroad. Thus the strip of country tributary to the railroad, increases in length with the length of the road, and in addition to this, it increases in width.